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13. ABSTRACT *(Maximum 200 words)*

The purpose of our visit was to promote the Taiwan AFOSR Nanoscience Initiative and encourage white papers for review and consideration of rfp (request for proposal) from the institutions visited. The goal of the Taiwan - AFOSR Nanoscience Initiative is to establish cooperative and mutually beneficial scientific interactions with researchers in Taiwan and scientists in AFRL. The primary motivation behind the Initiative is the recognition of the Taiwan government's commitment to establishing Taiwan as world class technical power with a proposed investment of NT$19.2B into an national nano science! technology program. AFOSR would like to take advantage of the fruits of such a program. The program is expected to launch officially in 2003 and continue until 2007.

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Nano Science / Technology
Taiwan Trip Report
(September 9 – 17, 2002)

AFOSR Contract No.: F49620 – 02 – 1 – 0447

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Table of Contents

Executive Summary ii

Itinerary / Technical Summary Statement 1

1. Academia Sinica 2

2. Industrial Technology Research Institute (ITRI) 4

3. National Taiwan University (NTU) 7

4. National Tsing – Hua University (NTHU) 12

5. Synchrontron Radiation Research Center (SRRC) 15

6. National Chiao – Tung University (NCTU) 16

7. National Central University (NCU) 17

8. National Cheng Kung University (NCKU) 18

9. National Science & Technology Museum (NSTM) 20

Institutions / Points of Contact / Web sites 21

Executive Summary

In February of 2002, the Air Force Office of Scientific Research (AFOSR) visited Taiwan. **The** purpose of that visit was to establish an initial dialog with the research leaders and research community in Taiwan, and exchange research visions without preset specific goals. Based on Taiwan's advancement in science and technology, AFOSR looked to obtain a general survey of the research environment and the basic research being conducted by universities, government, and industry in Taiwan. The AFOSR team shared its research experience and explored the potential for future collaborative research opportunities.

Delegation:

Col. Steven Reznick, Commander and Deputy Director, AFOSR
Dr. Herb Carlson, Chief Scientist, AFOSR
Dr. Forrest (Jack) Dr Agee, Director, Physics and Electronics Directorate, AFOSR
Lt. Col. Mark Nowack, Technical Director, Asian Office of Aerospace Research and Development - Tokyo, AFOSR
Dr. Joseph Dr Liu, Chief, Operational Astrodynamics, Space Analysis Center, HQ AFSPC
James Fillerup, International Office, AFOSR

The February trip was followed by another in August of 2002. This visit extended the goals of the February visit and essentially kicked off a cooperative program known as the Taiwan – AFOSR Nanoscience Initiative.

Delegation:

Lt. Col Anne Fay, AFOSR
Dr Brett Pokines, AOARD

Shortly after, in September 2002, a formal delegation, of which I was a member, visited Taiwan. The purpose of our visit was to promote the Taiwan – AFOSR Nanoscience Initiative and encourage white papers for review and consideration of rfp (request for proposal) from the institutions visited. The goal of the Taiwan – AFOSR Nanoscience Initiative is to establish cooperative and mutually beneficial scientific interactions with researchers in Taiwan and scientists in AFRL. The primary motivation behind the Initiative is the recognition of the Taiwan government's commitment to establishing Taiwan as world class technical power with a proposed investment of NT$19.2B into an national nano science / technology program. AFOSR would like to take advantage of the fruits of such a program. The program is expected to launch officially in 2003 and continue until 2007.

With this in mind, we visited eight institutions, which included five universities, listened to detailed presentations by numerous researchers and administrators, toured their facilities and shared social luncheons and dinners. The institutions visited where geographically located from

Taipei, northern Taiwan to Kaohsiung, southern Taiwan. This was done in essentially five working days

Because of the whirlwind nature of the visit and the volume of material presented to us it was impossible to assess and rank the relative quality of each place. However, I was very impressed with the enthusiasm and dedication at all of the institutions we went to and the people we met, especially those who returned from the US to "make it work" in Taiwan. It was apparent that each place was striving for excellence in research. I would nominally rate the universities with the top 25% of American universities: faculty, students and facilities. While there is competition among the universities for "who is the best" there is also a large degree of cooperation between them, government, and industry to make a world class success of their National Nano Science / Technology program.

The body of this report concentrates on a technical summary of the presentation material given at the various institutions.

Delegation:

Dr Lyle Schwartz, Director, AFOSR
Dr. Barbara Wilson, Chief Technologist, AFRL
Dr. Forrest (Jack) Agee, Director, Physics and Electronics Directorate, AFOSR
Col Donald R. Erbschloe, Director, Policy and Integration, AFOSR
James Fillerup, International Office, AFOSR
Dr. John Frazier, Lead, AFRL Biotechnology, AFRL/Human Effectiveness
Dr. Joseph Dr Liu, Chief, Operational Astrodynamics, Space Analysis Center, HQ AFSPC
Dr. James J. Carroll, Department of Physics and Astronomy, Youngstown State University
Dr. Frank L. Madarasz, Center for Applied Optics, University of Alabama in Huntsville.

Nano Science / Technology

Itinerary

Date and Time	Institution Visited	Place
9/11/02, AM	Academia Sinica	Taipei
9/11/01, PM	Industrial Technology Research Institute (ITRI),	Taipei
9/12/02, AM	National Taiwan University (NTU)	Taipei
9/12/02, PM	National Tsing Hua University (NTHU)	Hsinchu
9/13/02, AM	Synchrotron Radiation Research Center (SRRC),	Hsinchu
9/13/02, AM/PM	National Chiao Tung University (NCTU),	Hsinchu
9/13/02, PM	National Central University (NCU),	Hsinchu
9/14/02	National Science & Technology Museum, Dinner	Travel to Kaohsiung
9/15/02	Open	Travel to Tainan
9/16/02, AM/PM	National Cheng Kung University (NCKU)	Tainan
9/16/02, PM	Open	Travel to Taipei
9/17/02, AM	Open	Travel to USA

Technical Summary Statement: The following is a technical summary of the presentation material given at each institution that was visited. Electronic versions of the presentation material were collected and burned onto one CD, which will accompany this report. Specific details may be found on it. A master will be sent to AFOSR headquarters to be burned on officially labeled discs and distributed to the appropriate people and organizations within the AFRL's.

1. **Academia Sinica**
   Hosts: Dr. Sunney I. Chan, Vice President, and Dr. M.K. Wu, Director, Institute of Physics

Center for Nano Science and Technology:

- **Currently Four Areas of Research:**
  1. **Fabrications of Functional Nanomaterials,** Led by Institute of Atomic and Molecular Sciences
  2. **Organic Materials for Molecular Electronics,** Led by Institute of Chemistry
  3. **Characterization and Manipulation,** Led by Institute of Physics
  4. **Development and Applications of Nano-Biotechnology,** Led by Institute of Applied Science and Engineering

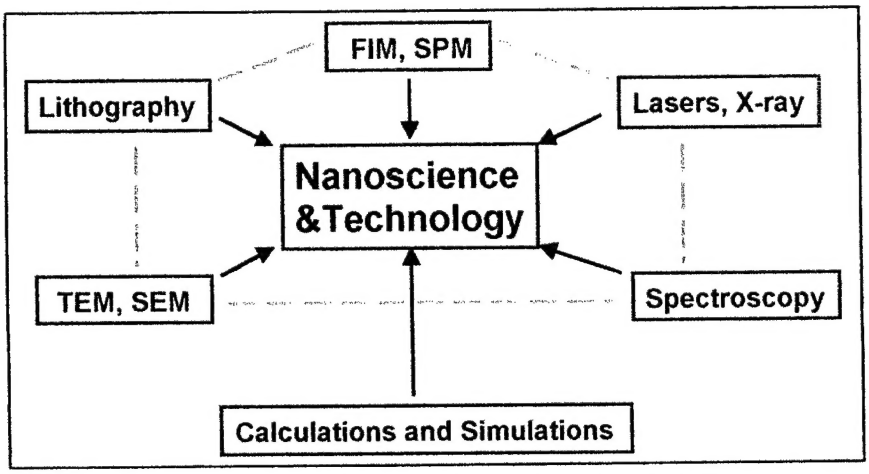
Fabrications of Functional Nanomaterials:

- Fabrication of Nanostructures
  - ♦ GaN Nanorods
  - ♦ SiC Nanotips
- Template for patternized growth
  - ♦ Highly Ordered AAO Template
  - ♦ Ga Magic Cluster Superlattice on Si(111)7x7
- Nanotructures on Surfaces
  - ♦ Well-aligned CNTs
- Application of Carbon Nanotubes

Organic Materials for Molecular Electronics:

- Self-Assembly in Solutions
  - ♦ One-dimensional organometallic wires
  - ♦ Cage type two-dimensional wires
- Self-Assembly on Surfaces
  - ♦ Self-assembly of nanoparticles covered with thiol
  - ♦ Self-assembly of supramolecular array on surfaces
- Molecular Switches
- Molecular Rectifiers

Characterization and Manipulation:



- Imaging by STM
- Transport Measurement by STM
- Single-Atom Tip in FIM
- Atomic Manipulation by STM
- Magnetic Force Microscopy
- E-beam Lithography
- Single Electron Transistor

Development and Applications of Nano-Biotechnology:

- DNA Chips Related Technology
  - High throughput DNA sequencing
- DNA Circuits Design and Fabrications
  - Nanowire patterning by self-construction of biomolecules
- High Sensitive Biosensor
  - Photonic bandgap waveguide based bio-detection

Institute of Applied Science and Engineering Research:

- **Research Groups:**
  - Nanotechnology Reseach Group
  - Bio Mems
  - Wireless Internet Project
  - Si / Ge Based Materials and Optical Devices
  - Air Assisted Ultrasonic Spray Pyrolysis for Nanoparticle Synthesis
  - Fuel Cell Research Group

- **Current Research Projects:**
  - ♦ Ultra thin Magnetic Ion Compound Semiconductor Based Wideband Integrated Microwave Devices
  - ♦ Table-Top High-Brightness Soft $\tilde{X}$ – Ray Lasers
  - ♦ An In – Situ Gene Chip Spliter
  - ♦ The Development and Applications of Photonic Crystals

- **Current Research Topics:**
  - ♦ Nanofabrication: Bottom-Up Approach
    - * Nanosphere Lithography
    - * Biosensor
  - ♦ Surface Spectroscopy: SFG
    - * Interfacial Studies
    - * IR Spectroscopy at Solid-Water Interfaces

There are three Academia Sinica Power Point presentations on the CD:

- **Center for Nano Science and Technology Academia Sinica**
- **Institute of Applied Science and Engineering Research,** Dr. Peilin Chen
- **Magnetic Field Tuned Superconductor – Insulator Transitions,** Dr. ChiiDong Chen, Institute of Physics

2. Industrial Technology Research Institute (ITRI)

Host: Dr. Jih Chang (Bob) Yang, Executive Vice President

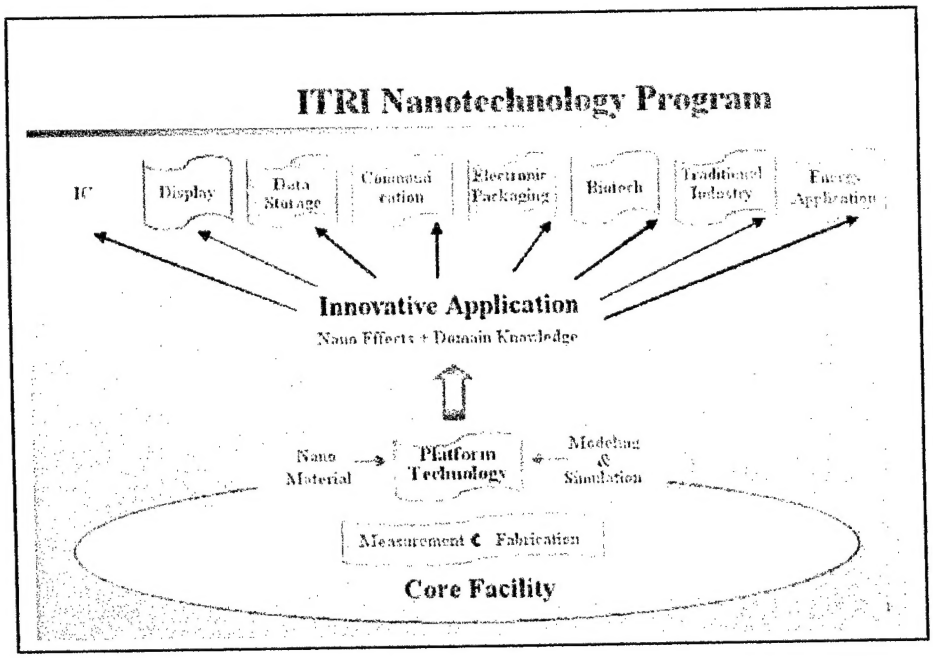
Presenter: Dr. Tsung-Tsan Su, Nano Technology Research Center

Objective: To turn Nano Technological Innovations into World Competitive Products within Five Years.

Mission:

- Create a New Infrastructure and Paradigm for Nanotechnological Innovations through Interaction, Integration, Collaboration and Incubation
- Incubate Top Performers in Pioneer Applied Research through Building First-rate Facilities and World-wide Networking
- Strengthen Nanotechnology Position through Advantageous Pioneer Patents from Innovative Research
- Integrate Nano Effects and Industrial Domain Knowledge to Identify New Opportunities and Enhance Competitiveness of Manufacturing Industry

ITRI Nanotechnology Program:



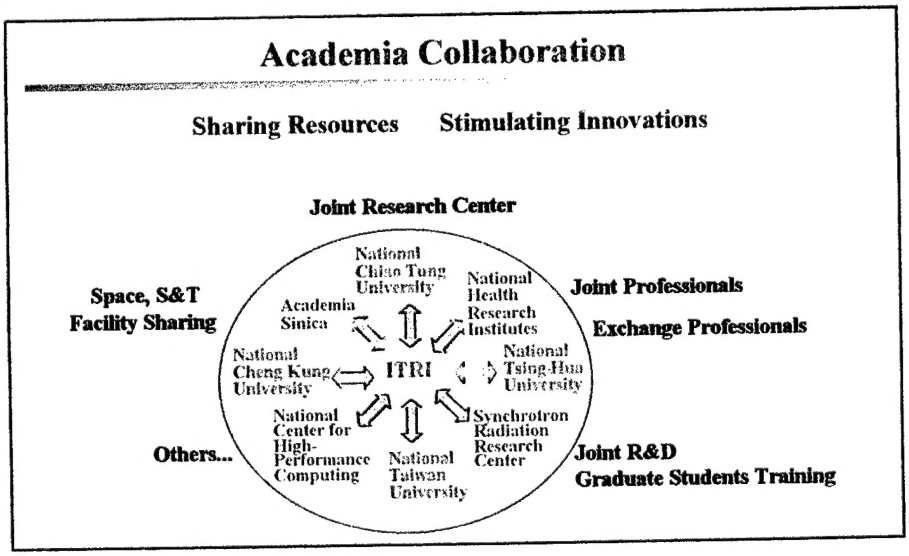
20^{+}/ 60 / 20^{-} Approach:

20^{+} – 20 percent of program resources goes to technologies that can be immediately applied (within 1 to 2 years); aimed at being "disruptive" to the existing market

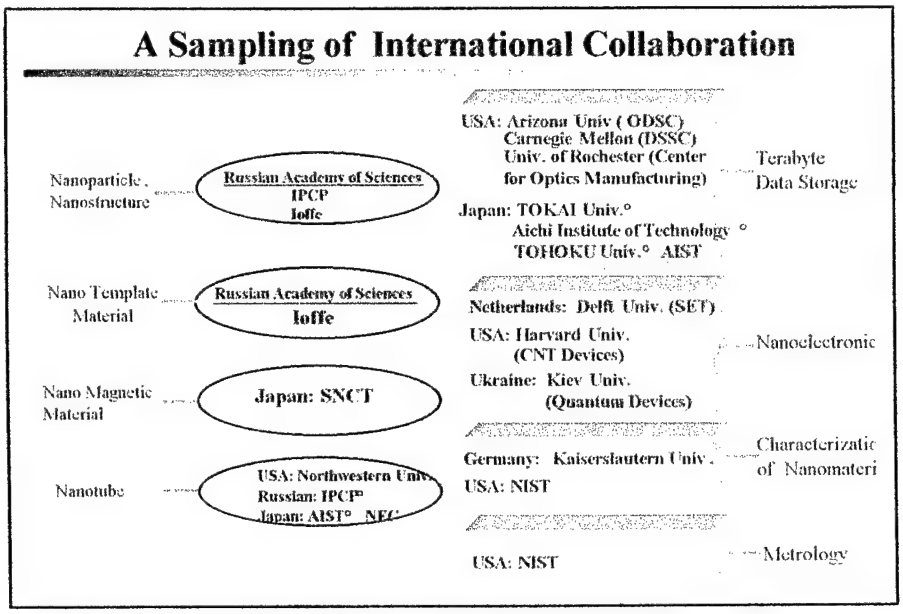
60 – 60 percent goes major future technological frontiers crucial to the competitiveness of Taiwan industries; aimed at "orders of magnitude" advances in 5 years' time

20^{-} – 20 percent goes to long-term R&D that may become "revolutionary" in 10 to 20 years' time

Academic Collaboration:



International Collaboration:



Examples Nano technologies and Nano Materials:

Carbon Materials

- Carbon Nanotube
- Composite Carbon Materials
- Carbon Nanocapsule
- Carbon Nanospiral
- High Heat Conductive Flexible Carbon Sheet
- Mesoporous Carbon

Zero-dimension Material

- TiO_2, Ferrite, ZnO,
- Complex Oxides
- Core-Shell Nanoparticle
- Nano Pigment
- Nano Catalyst

One-dimension Material

- Metal Wire
- ZnO Wire
- Polymer Wire

Bulk Material

- Polymer/Clay Nanocomposite
- Carbon-Implanted WC/Co

Quantum Dot

- Ge QD (Photodetector)
- SiGe MQW Phototransistor
- InAs/InGaAs QD 1.3μm Laser

Energy Application

- Separators for Ni-H Battery
- Direct Methanol Fuel Cell
- Nano Catalyst

Display Industry

- Nano Pigment ⇨ Ink Jet Printing, Color Filter
- Carbon Nanotube (Screen Printing, Low Temp Growing) ⇨ CNT-FED
- Low Voltage Blue Phosphor

Data Storage

- Mastering (70nm)
- Inorganic CD-R/DVD-R (ARMI)
- Super-RENS

Uniqueness in Developing Nanotechnology:

- Inherent organizational culture and capabilities in finding commercial uses for novel technologies
- Close linkages to the strongest sets of Taiwan industries for whom nano technology will soon carry substantial strategic meanings
- Extensive multidisciplinary capabilities ready to provide interdisciplinary solutions

There is one ITRI Power Point presentation on the CD:

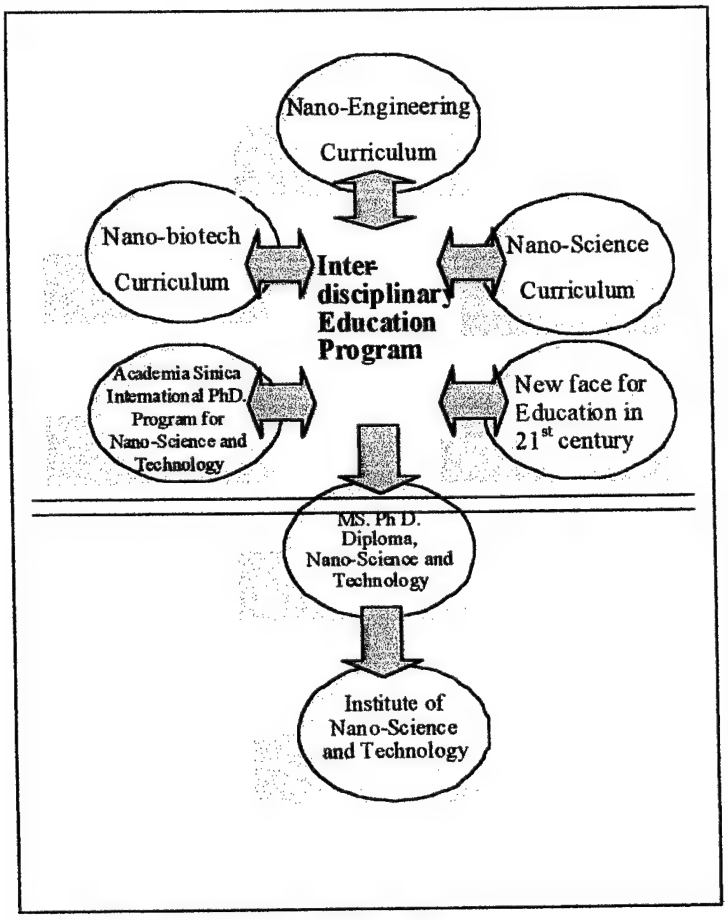
•**Industrial Technology Research Institute (ITRI),** Dr. Tsung-Tsan Su, Nano Technology Research Center

3. National Taiwan University (NTU)
Host: Prof. Wei – Jao Chen, President

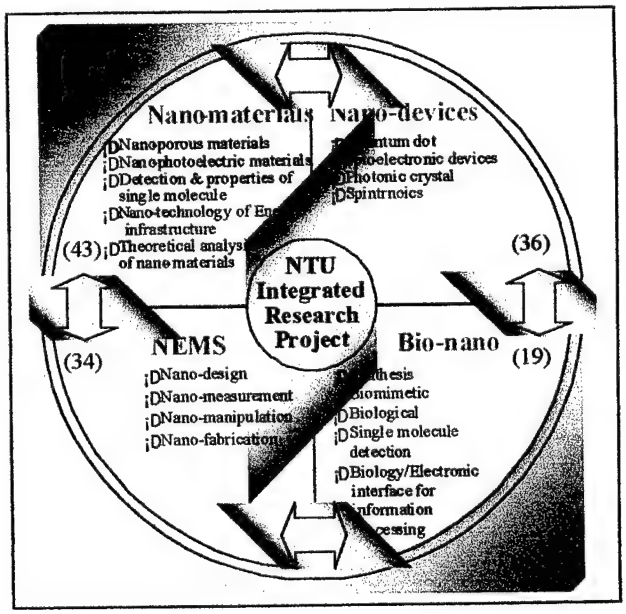
Center for Nano – Science and Technology:

- PI: Prof. S.M. Peng
- Co-PI's: Prof. Si. Chen Lee (Department of Electrical Engineering)
  Prof. T.J. Chuang (Center, Condensed Matter)
  Prof. Y.F. Chang (Department of Physics)
  Prof. Shuo Hung Chang, Director of MEMS Research Center, (Department of Mechanical Engineering)

Inter-Disciplinary Education Program:



CNST Integrated Research Projects:



Nano Materials (Yang Chen):

Synthesis of Nano Materials	Single Nano Particle Characterization	Superconducting Nano Structures and Qubits	Next Generation Energy with Nano Materials	Quantum Electronic Theory
Molecular Electronics	Capillary Electrophoresis-LASER-Induced Fluorescence	Quantum Computation	Direct Methanol Fuel Cells	Quantum Mechanical Electronic Structure Calculations
Supramolecular Architecture	Inverted Confocal LASER Scanning Optical Microscopty	Superconducting Qubits	Organic / Inorganic Solar Cells	
Inorganic Nano Materials for Opto-Electronics	Near Field Scanning Optical Microscopy	D-Wave Qubits and Qubit Arrays	Electrochemical Energy Storage Devices	
Organic / Inorganic Hybrids for Opto-Electronics	SEM / SCM	Mixed-State Hall Effect	Surface / Interface Characterizatons	
			Non-linear and Ultrafast Optical Spectroscopy.	

Nano Devices (S.C. Lee):

Nano Infrared Light Sources and Photodectors	Photonic Crystals and Embedded Quantum Dots	Switching Dynamics in Nano Structual Spintronic Devices
Quantum Dot Device Fabrication	Photonic Crystal Micro-Cavities	Fabrication of Highly Sensitive and High Speed Switching Thin Film Magnetic Junctions
Regular Quantum Dot Array Photodetectors	InAs/GaAs Quantum Dots Embedded in Photonic Mico-Cavities	Magneto-Optical Spectroscopy and Electronic Spin Dynamics
High-Speed Photodetectors	InGaN/GaN Quantum Dots Embedded in Photonic Crystal Micro-Cavities	
Enhance Si-Based Opto Electronic Devices		

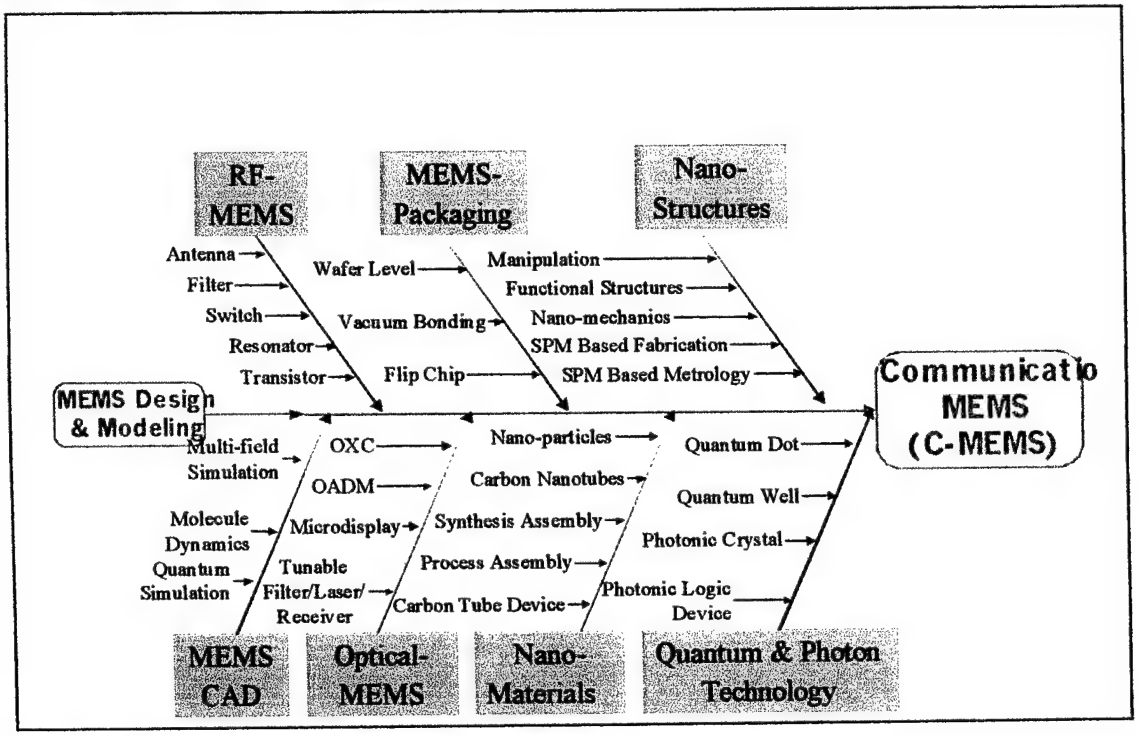
NEMS (H.P. Huang, C.k. Lee):

NEMS Design	Nems Metrology	NEMS Manipulation	NEMS Frabrication
Simulation of Nano Particles in Solution	Nano CMM	SPM Nano - Manipulation	Self – Synthesized Nano Films
Fullerness and Carbon Nanotubes for Lithium-Ion Batteries	Ellipsometry Analyzer	Nano Scale Systems Dynamics	Large Area LED's from Nano-Particles
Life Cycle of DPG Graphite Material	Automated Assembly System	Active Vibration Isolation	Hot Embossing of Nano-Particles
Lithium-Ion Incorporated Nano-Particles	SAW – Based Measurements	Pico – Liter Fluid Manipulation	Nano-Particles Injection Molding
High-Power Electrochemical Super-capcitors		Morphology of Amiphiphilic Block Copolymers	NTU / NTUST Cross University Colloids and Interface Science and Technology
Photo-Catalysts			

Bio Nano (C.M. Teng, S.M. Hsu, Y.M. Chen):

Synthesis	Bio - Mimetic	Clinical & Ecology	Molecular Detection	Bio - Interface
Receptor Probe	Nano-Vaccine	Free Radical	Bio – Chips	Polymer / Neuron
Recognition	Micromulsions Nano-Capsules	LDL / MMP – 1 Cormea Infection	Nano-Force Mapping	Electronics / Neuron
Bio-Analysis	Montmorillonite 5 – ASA	MRNA Tumor Makers	Ultra-Fast LASER Phenomena	
Bio – Chip Applications	RCA Drug Delivery	Abs DNA Probe for Agriculture	TPM / FCS	
Photo-Polymerization of Nano-Devices	Drug Efficacy by Nano-Technology	GFP	SQUID	
	Co-Polymeric Micelles			

MEMS / NEMS Center Technology Focus:



Examples of NTU MEMS Research Achievements:

Micro-Machined Pressure Sensor	CMOS-Based Actuator	RF Switch	3D Inductor
Vertical Hall Sensor	Magnetic-Electrostatic Torsion Mirror Array	Micro optical switch	Bio-chip
Nanometer Vibration Meter	Micro/Nano Coordinate Measurement Machine	Nano-Manipulation Platform	Six Degrees of Freedom Micro / nm – Positioner
SAW Delay Line	Nano / Pica Liter Fluid Control	Nano Particles Hot Embossing Forming	1-D Au-C60 Array Single Electron Transistor

There are four NTU Power Point presentations on the CD:

- **Study of Carbon Nanotube Additions on the Negative Electrode Performance of Ni / MH Batteries,** Sammy L.I. Chan, Department of Materials Science and Engineering
- **System Perspectives of Nanotechnology Developments: Biochips, LCD, Moire Lens & Power Supply,** C. K. Lee Professor, NEMS / MEMS Lab., Institute of. Applied. Mechanics
- **Nano-CMM for Measurements of Micro / Nano Parts:** PI: Prof. Kuang-Chao Fan, Co-PI: Prof. Tien-Tung Chung, Department of Mechanical Engineering

- **College of Engineering** - National Taiwan University

4. National Tsing – Hua University (NTHU)
Host: Prof. F. Shu, President

Nano Technology and MEMS Center
Objectives:

- Establishing core facilities and laboratories in Nano-technology and MEMS research
- Promoting multidisciplinary integration of research in Nano-technology and MEMS in Tsing-Hua University campus
- Bridging collaboration with other research institutes and industry in Nano-technology and MEMS

Activity of Nano-related Research Projects funded by Ministry of Education:

- Research on Novel Molecular, Nanostructured Materials and Thin Film
  - ♦ Sub-project: Research on the Nanostructured Materials and Thin Film
- Atomic Structure and Dynamic Behavior of Advanced Materials
  - ♦ Sub-project: Nano-material Science and Technology
  - ♦ Sub-project: Characteristics and Manipulation of Nanomaterials

Projects Funded by National Science Council:

- Synthesis and Applications of Nanosized Carbon-related Materials (6 Professors are involved)
- Development of Carbon Nanotube and Chemical Vapor Deposition Equipment for Field Emission Display

Nano Polymer Composite Materials Preparation, Processing and Characterization:
Materials:

- Polymers: Thermoplastics, PA, PET, TPO, TPU, PC, PEEK, PPS, ABS, etc.
- Themoset Resin: UP, Epoxy, Phenolic PI, PU, etc.
- Nanoparticles: Clay, Metal oxides, $CaCO_3$, Sol-gel, etc.

Processing and Characterization:

- Static and dynamic Rheology Chemorheology
- Kinetics Mechanism
- Morphology and Topology
- Mechanical properties
- Thermal properties and flame resistance

- Optical and Electrical properties
- 7. Molecular Structure and Design

Applications:

- Semiconductor
- Electronic and Optical
- Photo-electronic
- Battery
- Nanopackaging materials
- 6. EMI/ESD
- Flame Resistance

Key Issues For Developing 1-D Photonic Crystal:

- Design – Theoretical calculation of group velocity, including oblique angle of incidence. Tolerances.
- Material – Large differences between n_H and n_L are required.
- Fabrication process—Ion beam sputter (IBS), Ion beam assisted sputter (IBAS), Process from VCSEL (LPE, MOCVD, MBE....)

NTHU / ITRI Forum on Nanotechnology:

- Carbon Nanotubes
- Nanophotonics
- Nano Chemistry and Nano Composites
- Biology and Nanotechnology
- Micro/Nano System Interface
- Characterization and Nano-metrology
- Strategy and Application of Nano-technology on Optical Communication
- Nano-CMOS
- Coversation of Buddahnism with Nanotechnology and Biotechnology
- Nano Quantum Dots

Some Project Proposals Under Planned for National Science Council:

- Investigation of nano-physics and -chemistry in the micro-scale direct methanol fuel cell
- Characteristics and Application of Nano-PZT Crystals
- Nano-Magnetics

- Using self-assembly to create tailor-made nano-structures with biological materials, including lipids, peptides, DNA and proteins
- Fundamental Aspects on Nano-structure and Devices
- Tunable photonic crystal _fabrication and application
- Investigations on GaN & Si Nano Dots and Their Applications
- The Study of Nano-biomolecule Interaction Using Bio-MEMS Technology – Development of DNA/Lipid/Carbohydrate/ Protein Micro Array for Cancer Diagnosis

Activity of MEMS Research ProjectsFunded by National Health Research Institutes and Others:

- Micro-Tissue Chip
- Micro0Blood Sensing Array
- Micro-Needle Electrode Array
- Stamped Micro Array Protein Chip
- Droplet Generators
- Micro Febry Perot Shear Stress Sensor

Activity of MEMS Research Projects Funded by National Health Research Institutes and Others:

- Micro-Tissue Chip
- Micro Blood Sensing Array
- Micro-Needle Electrode Array
- Stamped Micro Array Protein Chip
- Droplet Generators
- Micro Febry Perot Shear Stress Sensor

Research and Applications of Quantum-Dots in Nanophotonics and Nanoelectronics (Prof. Huey-Liang Hwang, Director of Nano Technology and MEMS Center):

- Study on Wide-Gap Gallium-Nitride Based Films and Their Quantum-Dots
- Growth of Silicon-Based Quantum Dot Superlattice Structures for Applications in Nanoscale Optoelectronics

There are three NTHU Power Point presentations on the CD:

- National Tsing Hua University Introduction (NTHU ENGLISH)
- Nano Technology and MEMS Center (NTMC-20020912.PPT)
- Quan Dots Res & Appl

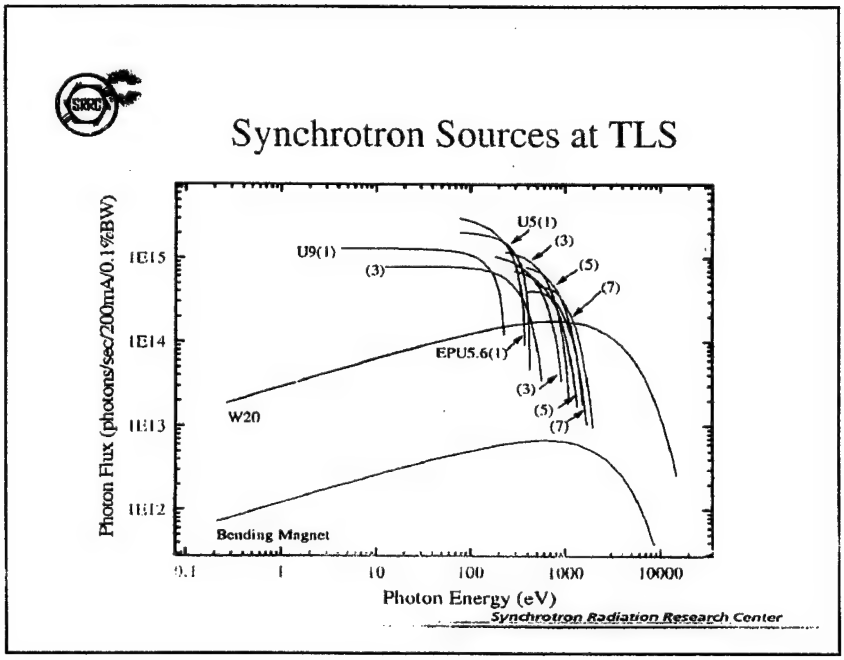
5. Synchrontron Radiation Research Center (SRRC)

Hosts: Dr. Chien – Chen, Director and Dr. Keng S. Liang, Deputy Director

Research & Beamline Division, K. Liang (M.L. Lu):

Beamline Division K.L. Tsang (M.Y. Huang)	**Research Division** B.M. Cheng (M.Y. Huang)	**User Administration** Ruth Wu
Beamline R&D P.C. Tseng Experimental Support S.C. Chung	Atomic & Molecular Science K.D. Lee Condensed Matter Science J.M. Chen	
	Magnetism & Fermiology H.J. Lin	
	X-Ray Materials Research H.H. Hung	
	X-Ray Biostructure Y.C. Jean	
	Microstructure Fabrication Y. Chen	

Sybchrotron Radiation Sources:



6. **National Chiao – Tung University (NCTU)**
Host: Prof. W.H. Tasi, Vice President
Director of Center for Nano Technologies: Dr. C.P. Lee

Activities:

- CNST was formally established on Nov 9, 2001
- Has sponsored Tera Hertz, Spintronics, and Transport Phenomena in Nano Structure Symposiums
- Nano Forum: Bi-weekly seminar in Nano Science and Technology
- Inter-departmental course of Nano Science (more than 200 students enrolled)
- More than 50 faculty members are actively involved in Nano science research
- A central laboratory is being established in the semiconductor research center with complete clean rooms and necessary facilities

Nano Science and Technology:

Nano Sciences Prof. C. H. Chu	**Nano Materials** Prof. H. T. Chiu	**Nano Devices** Prof. C. P. Lee
Physics	Material Science	Electronics Engineering
Electro Physics	Applied Chemistry	Electro Optical Engineering
Applied Chemistry	Biological Science	Computer Science
Applied Mathematics		Biological Science
		Semiconductor Research Ctr.

Research Areas:

Nano Sciences:

- Spin dependent transport and confinement in semiconductor nanostructures
- Nano-scale real-time observation of surface growth mode
- Quantum transport and heat transport in granular metal films
- Probing the electron dephasing times in mesoscopic sturctures
- Quantum pumping in nanostructures

Nano Materials:

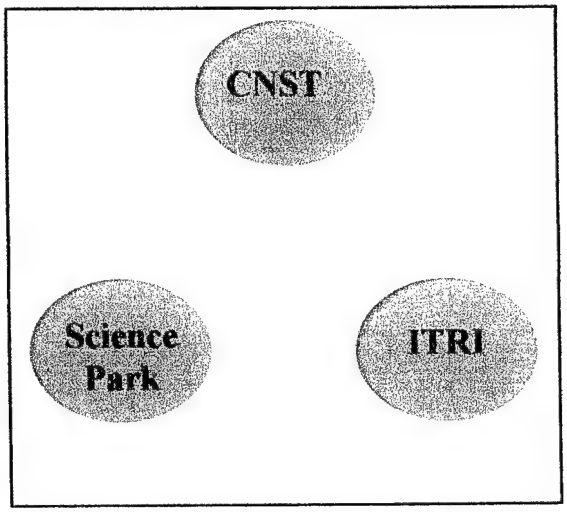
- Carbon Si-C-N, TiO_2 Nanotube
- Cu and C nanorods
- Nanoconposites
- Luminescent Nanoparticles
- Nanoparticle and Nanowire of conducting polymer

Nano Technology:

- Fabrication and Growth of Semiconductor Nano Structures
- Selective Quantum Dot Growth, Growth of quantum anti-dots

- Semiconductor Quantum Optoelectronic Devices
- Spin-dependent phenomena in Nano Devices
- Single Electron Devices
- Carbon Nanotube Field Emission Devices
- Micro-Analysis of Nano-Devices

Circularly integrated R&D program:



There are two NCTU Power Point presentations on the CD:

- **Center for Nano Science and Technology**
- **Biological Science and Technology**

7. National Central University (NCU)
Host: Prof. C.H. Liu, President

Areas of Nanotechnology Focus:

Nano-Materials	Nano-Photonics	Nano-Science
Chemical Synthesis	Quantum Dot Lasers and Detectors	Electro-Optical Properties
Electro-Deposition	Single Photon Source & Quantum Information	Magnetic Properties
Chiral Selectivity for CNT		Thermal Properties
Nanometallics/Nanomagnetics & Superc onductivity		
Semiconductor Quantum Dots		
Quantum Dot Spectroscopy		

Nano-Devices Research at Optical Science Center:

- Advanced Technology Project – NSC
  - ♦ GaN-based optoelectronic devices
    - * UV, blue, green LEDs, LDs, HEMTs, RTDs, and QDs
- Program for Promoting Academic Excellence of Universities- Ministry of Education
  - ♦ Integrated micro-optoelectronic devices and systems
    - * Optical MEMS, QDs, Violet LDs, Photonic crystals, and
    - * Novel devices
- Technology Development Program for Academia- MOEA
  - ♦ Key components for fixed wireless communication systems
    - * Digital/analog chipsets, InP-based MMICs, OEICs, and DWDM gratings

There is one NCU Power Point presentation on the CD:

- **Nanoscience / Nanotechnologies**

8. National Cheng Kung University (NCKU)
Host: Prof. Chiang Kao, President
POC: Dr. Fei – Bin Hsiao, Associate Dean of Engineering and Director of the Micro/Nano Technology Research Center

Mission:

- ♦ Establish Common Laboratory and Its Facilities
- ♦ Build Up and Develop MEMS Technologies
- ♦ Provide Educational and Training Courses
- ♦ Support and Promote MEMS Research in Academia and Industry

Focus Areas:

- ♦ Bio-MEMS and MEMS for Health Care
- ♦ Precision Micro-machining Technology
- ♦ Nano-Technology

Marquee Equipment:

- Plasma Enhance Chemical Vapor Deposition
- Reactive Ion Etching (RIE)
- Deep Reactive Ion Etching
- Oxidation Furnace
- Double Sides Mask Aligner
- Spin Coater
- Optical Microscope
- Wire Bonder
- NanoSpec
- Super Critical CO_2 Dry Release
- Mask Writer
- Electroforming System
- Ultra High Vacuum Sputter
- Parylene Deposition System
- Nano-Indentor
- Wafer Cutting
- Alpha-Step
- Probe Station
- E-Beam Evaporator
- Sputter Deposition
- Ellipsommetry
- Four Point Probe
- Atomic Force Microscope
- Confocal Microscope
- Excimer Laser Micro-Machining System
- MEMCAD Simulation Software

Research Achievements:

- Bio-Chips
- Biomedical Sensing
- Actuator and Sensor
- Nanomaterials and Nanotechnology
- Micro-fabrication and Micromachining

- **Nano Research Achievements:**
  - Nano Materials
  - Nanoparticle, Carbon Nanotube, Quantum Dot
  - Nano Medicine
  - Biosensor, microchip
  - Nano Electronics
  - Quantum Dot Laser
  - Nano Machining and Metrology
  - Micro/Nano Tribology, Nano lithography
  - Molecular/Atomic Dynamics Simulation
  - Quantum Information Science

SPRAX Lab Presentation
Presenter: H.H. Chiu, Director

Quantum Fluid Dynamics/Nanoscience and Technology Research/SPRAX Lab

- **New "Quantum Diffusive Fluid Mechanics" offers unique approach to quantum and nano systems**
  - ♦ Quantum diffusive fluid mechanics = Quantum fluid mechanics
    - * Quantum energy formalism= Classical fluid mechanics
    - * Quantum constraints + Quantum energy formalisms
  - ♦ Applications in the ontological and methodological analysis led to major breakthroughs in quantum and nanosystem energetics.

- **Impacts on Quantum Physics and Nanoscience**
  - ♦ New concepts in quantum energy provides a unified view of the physics of the "energy" at the most fundamental level.
  - ♦ Quantum energy based physical view of nanoscale energy systems, measurements conversion, and invention of quantum energy sensors and converters

There are two NCkU Power Point presentations on the CD:

- **Micro/Nano Technology Research Center,** Prof. Fei-Bin Hsiao, Director
- **SPRAX,** H.H. Chiu, Director

9. **National Science & Technology Museum (NSTM)**
   Hosts: Dr. Hong – Sen YAN, President
   Dinner at the Spendor Hotel, Kaoshsiung, TW

Institutions / Points of Contact / Web sites

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